A Breviate of Monfieur Picarts *Account of the Meafure of the Earth.*

THIS Account hath been printed about two years fince, in *French*; but very few Copies of it being come abroad, (for what reafons is hard to divine;) it will be no wonder, that all this while we have been filent of it. Having at length met with an Extract thereof, and been often defired to impart it to the Curious; we fhall no longer refift thofe defires, but faithfully communicate in this Tract what we have received upon this Argument from a good hand.

The Author then, whofe name is not prefixed to the Book (though generally 'tis thought to be the Intelligent and Learned *Picartus*, an Eminent member of the Royal Academy of the Sciences at *Paris*,) divides his Treatife into 13. Articles; of which we fhall firft of all reprefent the fum, as 'twere, in one view; and then, for the fatisfaction of the more curious, deliver the Ereviat of every Article.

The Sum then of the whole amounts, in fhort, to this; That the French Author hath found 57060 toifes or fathoms for one degree, that is, 28½ leagues and 60 toifes; which being multiplyed by 360 (the number of the degrees) makes 10270 leagues and 1600 toifes, reckoning 2000 toifes to a league, or 2400 paces, 5 foot to a pace. The Method employ'd by him hath been, To meafure on a plain and ftraight ground a fpace of 5663 toifes, to ferve for the firft *bafis* to divers Triangles, by which he hath concluded the Length of a Meridian line to be equivalent to a degree. That which is remarkable for the certainty of this Obfervation, is, 1. That no body, we know of, hath ever meafur'd fo great a *bafis*; the greateft of the former Obfervations having been but of a 1000 toifes. 2. That here have been employed, for taking the Angles of pofition, very accurate Inftruments, and Telefcopical Sights inftead of common ones; all defcribed in the faid Book: of which we fhall now proceed to deliver the import of every Article.

In the *firft* then, he begins with a Preamble, fhewing, that this Probleme concerning the Juft Dimenfions of the *Circumference of the Earth* is no New thing, but hath been the Inquiry of feveral Ages, in which Princes have been curious, and Learn'd men encouraged to the fearch and clearing of this Difficulty. And to

M m   this

this purpofe he alledges a paffage out of *Abulfeida*, to this effeﬅ, that *Almamon*, a Prince of the *Arabes*, defirous to know, what the True meafure of a Celeftial *Degree* might be upon Earth, commanded the Experiments to be made in the Plains of *Sanjar*; where a Station being chofen, and thence Troups of Horfemen let out, that went in a ftraight line, till one of them had raifed a degree of **Latitude,** and the other had depreft it; at the end of both their marches, they who raifed it, counted 56½ miles, and they who depreft it, reckon'd 56 miles juft. This Obfervation can inftruﬅ us but very little, becaufe we know not juftly, of what length thefe miles were. Then, the Author obferves, that the Ancient computations of miles for a Degree run alwayes upon the decreafe; fo as *Ariftotle* counting to a Degree 1111 *ftadia*, after him *Eratofthenes* counted but 700; *Poffidonius* but 666; *Ptolomy* but 500. Nor do thefe Obfervations teach us any thing certain, becaufe the precife length of thefe *ftadiums* is unknown to us; and they were alfo different among themfelves; the *ftadia* of *Alexandria* differing from thofe of **Greece.** At laft *Fernelius* brought it to 56746 *Toifes* or Fathoms of *Paris,* each of which is equal to 6 *Parifian* feet; *Snellius,* to 55021.

In the fecond *Article,* he judges *Snellius* his way of meafuring to be the moft artificial; which was by a *Scale* of *Triangles.* But in one thing he efteems it deficient, which is, that *Snellius* took his Objeﬅ only by Pinnules, or Common Sights, which do not fo diftinﬅly point it out.

In the *third* Article he begins to fpeak of his own Method, and its exaﬅnefs, and faith, That, when the refolution was taken of See Fig. 1. *Meafuring a Degree,* he chofe his *Meridian,* out of which Tab. 1. he intended to take his Meafure, between *Sourdon* in *Picardy,* and *Malvoyfin,* which is upon the confines of the *Gaftinois* and *Hurepois.* To attain the exaﬅ Meafure of this Arch of the Meridian, lying between *Sourdon* and *Malvoyfin,* he faith, he aﬅually meafur'd a way that lay very ftraight, between *Villejuifve* and *Ivoify,* viz. A. B: And he began to meafure from the middle of a Mill at *Villejuifve,* and continued till he came to the Pavillon of *Ivoify,* and found the diftance between thefe two termes, in going forward, to be 5662 toifes and 5 feet, and in comming back, 5663 toifes and 1 foot; which being meafured with great exaﬅnefs, he ftated the diftance between thefe two places, in round reckoning, 5663 toifes.

The

The Inftrument he meafured with, was Pikes joyned together at their ends by a fcrew, which meafure was 4 toifes long: This he applied along a cord ftretched horizontally, and at the end of every fuch Pike had a ftake; of which ftakes he had 10 in all. This diftance of 5663 toifes was the Bafe of the *firft* Triangle, upon which the meafure of all the depending fcale was formed.

Here in *Art.*4. he takes occafion to difcourfe of *Meafures* in general, and faith, That a *Pendul* vibrating a *fecond* of time, computed according to the *Mean* motion of the Sun, is 36 inches and 8½ lines of the Chaftelet of *Paris* meafure. And he efteems, that this Meafure may probably ferve in all Countries, becaufe the fame Length of a Pendul ferved for a *Second* both at the *Hague* and *Paris*; whence he conjectures, the fame may ferve alfo in other Latitudes. Whereupon he inferrs, that if one had a mind to conftitute an *Univerfal Meafure*, which might be common to all Countries, it might be thus made, *viz.*

Call this Pendul for *feconds* (of 36 inches and 8½ lines) the Aftronomical *radius*; the ⅓ of this *radius* the *Univerfal foot*; the double of which *radius* might be called the *Univerfal Toife* or Fathom, which would be to the *Parifian Toyfe* as 881. to 864; the Quadruple might be called the *Univerfal Perch*, which is equal to the length of a Pendul for *two* feconds. In a word, the *Univerfal Mile* might contain a 1000 of thefe Perches.

The Inftrument, (in *Art.*5.) wherewith the Angles were taken in the Menfuration of the Triangles, was a Quadrant of 38 Inches *radius*, furnifh't with Telefcopical-glaffes, the better to point out the Objects: Which Inftrument, he faith, never mifs'd a minute in taking an Angle; fometimes it came within *five* feconds.

But to proceed; In the *fixth* Article he relates the Manner of taking the Diftance between *Sourdon* and *Malvoyfin*, together with the Triangles, and the Stations from whence he obferv'd his Angles. This diftance is 68343 toifes and 2 feet.

The *Bafe*, which he actually meafur'd, as we faid above, was AB, the high way lying between *Villejuifve* and *Ivoify*, which he found, (as hath been already intimated) equal to 5663 toifes of *Paris*. And from this Bafe he deduced the meafure of all the 13 Triangles, *viz.*

In

In the *first* Triangle ABC, to find the side AC, BC.

Angles
{ CAB = 54°. 4′. 35″.
{ ABC = 95. 6. 55.
{ ACB = 30. 48. 30.

Toises. Feet.
The Side AB is   5663. of actual measure.
Hence AC is   11012. 5.
       BC   8954. 0.

In the *second* Triangle, ADC, to find DC and AD.

Angles
{ DAC = 77°. 25′. 50″.
{ ADC = 55. 0. 10.
{ ACD = 47. 34. 0.

Toises. Feet.
The Side AC is   11012. 5.
Hence DC   13121. 3.
       AD   9922. 2.

In the *third* Triangle, DEC, to find DE, CE.

Angles
{ DEC = 74°. 9′. 30″.
{ DCE = 40. 34. 0.
{ CDE = 65. 16. 30.

Toises. Feet.
The Side DC   13121. 3.
Hence DE   8870. 3.
       CE   12389. 3.

In the *fourth* Triangle, DCF, to find DF.

Angles
{ DCF = 113°. 47′. 40″.
{ DFC = 33. 40. 0.
{ FDC = 32. 32. 20.

Toises. Feet.
The Side DC   13121. 3.
Hence DF   21658. 0.

In the *fifth* Triangle, DFG, to find DG, FG.

Angles
{ DFG = 92°. 5′. 20″.
{ DGF = 57. 34. 0.
{ GDF = 30. 20. 40.

Toises. Feet.
Side DF   21658. c.
Hence DG   25643. 0.
      FG   12963. 3.

In

In the *sixth* Triangle, GDE, to find GE.
The Angle GDE = 128°. 9'. 30".

		Toifes.	Feet.
The Sides {	DG	25643.	0.
	DE	8870.	3.
Hence GE		31897.	0.

So then, the Line of Diftance between *Malvoyfin* and *Sourdon* being divided into three parts, *viz.* EG, GI, IN, the part EG is already found.

In the *feventh* Triangle FGH, to find GH.

Angles {
FGH=39°.51'. 0".
FHG=91. 46. 20.
HFG=48. 22. 30.

		T.	F.
The Side FG		12963.	3.
Hence GH		9695.	0.

In the *eighth* Triangle GHI, to find GI, IH.

Angles {
GHI=55°. 58'. 0".
GIH=27. 14. 0.
IGH=96. 48. 0.

		T.
The Side GH		9695.
Hence GI		17557.
HI		21037.

Thus the *Second* part of the Three, *viz.* GI, is found.

In the *ninth* Triangle HIK, to find IK.

Angles {
HIK=65°. 46'. 0".
HKI=80. 59. 40.
KHI=33. 14. 20.

		T.
The Side HI		21043.
Hence IK		11678.

In the *tenth* Triangle IKL, to find KL, IL.

Angles {
LIK=58°. 31'. 50".
IKL=58. 31. 0.

		T.	F.
The Side IK		11683.	0.
Hence KL		11188.	2.
IL		11186.	4.

In

In the *eleventh* Triangle KLM, to find LM.

Angles $\begin{cases} LKM=28°. 52'. 30''. \\ KML=63. 31. 0. \end{cases}$

                T.   F.

The Side KL   11188. 2.

Hence LM   6036. 2.

In the *twelfth* Triangle LMN, to find LN.

Angles $\begin{cases} LMN=60°. 38'. 0''. \\ MNL=29. 28. 20. \end{cases}$

                T.   F.

The Side LM   6036. 2.

Hence LN   10691. 0.

In the *thirteenth* Triangle ILN, to find NI.

The sum of the Angl. IKL, KLM, MLN, taken from 360, there remains
Angle ILN=119°. 32'. 40''.

                T.   F.

The Sides $\begin{cases} LN & 10691. 0. \\ IL & 11186. 4. \end{cases}$

Hence IN   18905. 0.

Thus, the Line of Diftance, EN, being, as hath been faid, divided into three unequal parts, EG, GI, IN, the meafures of all three are found by this Scale of Triangles.

Now then, reaffuming what hath been already difcover'd by the help of thefe Triangles, and finding, that

                  Toifes.

EG was in length 31897.

GI   17557.

IN   18905.

Thefe added together, make the length of EN, which is the Line of Diftance between *Malvoyfin* and *Sourdon*, viz. 68359.

Now to continue this meafure from *Sourdon* to *Amiens*, (which is the bufinefs of the *feventh* Article, undertaken to the end that *Fernelius* his account might be liquidated, whether it were true or no;) you muft, for the attaining it, make ufe of the Diagram of Fig. 2; where R. ftands for the Steeple of St. *Peters* in *Montdidier*; T. is a Tree upon the Hill of *Mareuil*; V. is the Lantern of *Noftre Dame* of *Amiens*.

To find the diftance NV, you muft look back upon NLM, the laft Triangle of Fig. 1, and fee, how it is difpofed in Fig. 3; where in the Triangle LMR,

                                                   The

The Angles $\begin{cases} LMR=58°. 21'. 50''. \\ MRL=68. 52. 30. \end{cases}$

                T.   F.

The Side LM   6037. 0.

Hence L.R   5510. 3.

In the Triangle NRL.

The Angles $\begin{cases} NRL=115°. 1'. 30''. \\ RNL= 27. 50. 30. \end{cases}$

                T.   F.

The Side LR   5510. 3.

Hence NR   7122. 2.

Go on to Fig. 2. in the Triangle NRT.

The Angles $\begin{cases} NTR=72°. 25'. 40''. \\ TNR=67. 21. 40. \end{cases}$

                T.   F.

The Side NR   7122. 2.

Hence NT   4822. 4.

Finally in the Triangle NTV,

The Angles $\begin{cases} NTV=83°. 58'. 40''. \\ TNV=70. 34. 30. \end{cases}$

                T.   F.

The Side NT   4822. 4.

Hence NV   11161. 4; which was fought.

                                          T.   F.

Now, adding the Dift. between *Malvoyfin* & *Sourdon, viz.* 68359. 0.
to the diftance between *Sourdon* and *Amiens*   11161. 4.

The whole will be the dift. between *Malvoyfin* & *Amiens* 79520. 4.

    Having thus meafured the particular diftances between *Malvoy-fin*, *Mareuil*, *Sourdon*, and *Amiens*, he proceeds to examine, in the *eight* Article, the Pofition of each of thefe Lines of diftance in re-fpect of the *Meridian*, or to deduce the Length of the Meridian in-tercepted between the Parallels of *Malvoyfin* and *Amiens*: Which was thus done;

    In *Septemb.* 1669. he went to the Hill of *Mareuil*, and from the top of it, which is mark't with G in *Fig.* 1. (from whence one can difcern *Clermont* on one fide, at I, and *Malvoyfin* on the other fide, at E.) he took the *Meridian*, and with a Quadrant took the Angles of Declination from this Meridian. The manner he relates at length; the refult whereof is, That by thefe Obfervations he found,

                                                              The

The Angle EGε in *Fig.*1, which is the Declination of EG from the Meridian weftward ... gr. ′ ″ 0. 26. 0.

The Angle GIθ, which is the Declination of G I from the Meridian Eaftward ... 1. 9.

The Angle INV, which is the Declination of IN from the Meridian Eaftward ... 2. 9. 10.

The Angle VNβ in *Fig.* 2. which is the Declination of NV from the Meridian Weftward ... 18. 55. 0.

So that in all thefe 4 Triangles, EGε, GIθ, INV, VNβ, you have two Angles known (for the Angles at ε, at θ, at V, at β, are right,)and a fide, *viz.* EG. GI. IN. NV. whence he concludes,

	Toifes.	Feet.
The length of the Meridian Gε to be	31894.	0.
of the Meridian I θ	17560.	3.
of the Meridian NV	18893.	3.
of the Meridian N β	10559.	3.

And hence the length of the whole Meridian α β between the Parallels of *Malvoyfin* and *Amiens* to be ... 78907. 3.

Here he cafts in an Objection, and faith, that thefe Lines, which make up the Meridian, are not, in a ftrict fenfe, a Curve, but in reality the fide of a Polygone circumfcribed about the Circumference of the Earth. But, for anfwer to this, he affirms the Difference between thofe Lines and a true Curve to be but 3 foot *per* degree, which he faith is fcarce worth taking notice of. This he proveth afterwards, where he makes the Table, in which he calculates, what difference there is between the real Level and the apparent.

To this he fubjoyns a Note, importing, that though he took thefe Meridians, for greater exactnefs, with a Quadrant ; yet he omitted not to ufe a Compafs, whofe Declination to the *Weftward*, he faith, in the Year 1670, towards the end of the Summer, he found ... 1°. 30′.

Whereas *A.* 1666. he obferved very little variation, if any at all.

But *A.* 1664. it varied *Eaft-ward* ... 0. 40.

Here he makes a pretty Note, telling us, that the Difference of Variation in a years time amounts to ... 0. 20′.

The Length of the Meridian between *Malvoyfin* and *Amiens* being thus ftated, his next bufinefs is, in the *ninth* Article, to enquire, What anfwers to it in the Heavens, comparing thofe Meridian diftances, already meafur'd, with *Minutes* and *Seconds* there : which

were

were taken by the help of an Inftrument, whofe Limb was an Arch of $\frac{1}{20}$ of a Circle of 10 foot *radius*; whereof he gives the *Figure*, and his manner of rectifying any Errors, which in ufing it might deceive him.

In the *tenth* Article he relates, that the *knee* of *Caffiopeia* was the Starr he pitch't on, from whence to meafure the *Minutes* and *Seconds* of a Degree in the Heavens; adding the reafons, why he chofe that Starr.

In the *eleventh* he gives the refolution of the thing in Queftion, that is to fay, How many Toifes or Fathoms, *Parifian* meafure, anfwer a *Degree* of the *Circumference* of the *Earth*; as for inftance, the Difference of Latitude between *Malvoyfin* and *Sourdon* is found, by Obfervations made in the Heavens, to be 1°. 11'. 57".
Between *Malvoyfin* and *Amiens* 1. 22. 55.

Now, the Meridian diftance between *Malvoyfin* and *Sourdon*, calculated from Meafures taken upon Earth, was, Toifes. Feet. as may be feeen above 3 60430. 3.

Whence 'tis concluded, that 57064 Toifes and 3 feet, or, in a round number, 57060 Toifes are equal to a *Degree*.

Which if you would reduce to *Univerfal Meafure*, you are to remember, that the *Univerfal* toife is to the *Parifian*, as 881 to 864: Whence one Degree is equal to 55959 Toifes *Univerfelles*.

The Reduction of which to the meafures of other Countries is this ; parts.

Suppofe the *Paris* foot to confift of 1440.
The *Rhynland* (or Leyden) foot, contains of thefe 1370.
The *London*-foot 1350.
The *Bolonian*-foot 1686.
The Braccia of *Florence* 2580.

Hence a *Degree* in a grand Circle of the Earth, according to the Meafures of different Countries, is,

Toyfes du Chaftelet de Paris 57060.
Pas de Bologna 58481.
Verges du Rhin de 12 *pieds chacune* 29556.
Lieuës Parifiennes de 2000 *Toifes chacune* 28$\frac{1}{4}$.
Lieuës moyennes de France d'environ 2282 *Toifes* 25.
Lieuës de marine, de 2853 *Toifes* 20.
*Milles d'*Ang'eterre, *de* 5000 *pieds ehacune* 73$\frac{7}{10}$.
Milles de Florence, *de* 3000 *braffes* 63$\frac{7}{10}$.

N n Hence

Hence the *Circumference* of the *Earth,*

    In Parifian Toifes or Fathoms   20541600.

    In Leagues of which 25 make a Degree   9000.

    In Marine Leagues   7200,

The *Diameter* of the *Earth* is,

    In Parifian Toifes   6538594.

    In Leagues of 25 to a Degree $2464\frac{16}{71}$.

    In Marine Leagues $2291\frac{19}{71}$.

He alfo gives a Table, fhewing the Correfpondent value in mea-
fure to the parts of a Degree : E. g.

Min. Toifes.	Second. Toifes.
1 = 951	1 = 16.
2 = 1902	2 = 32.
60=57060	60=951.

After this follows a Table of the Difference of Latitude,
which is

Between *Malvoyfin* and the *Obfervatoire* of *Paris*   19'. 22".

Between *Malvoyfin* and *Noftre Dame de Paris*   20. 22.

Between *Malvoyfin* and

    Mareuil   33. 32.

    Clermont   52. 0.

    Sourdon   71. 52.

    Noftre Dame d' Amiens   82. 58.

Between *Noftre Dame* of *Paris* and of *Amiens*   62. 36.

Then follows a Table of Elevations of the Pole of feveral
places, as

The Elevation of the Pole

    In the Garden of the R. Academy at

        Paris is,   48°. 58'. 0".

    At *Noftre Dame de Paris*   48. 52. 10.

    At St. *Jaques dela Boucherie*   48. 52. 20.

    At *Malvoyfin*   48. 31. 48.

    At the *Obfervatoir* of *Paris*   48. 51. 10.

    At *Marevil*   49. 5. 20.

    At *Clermont*   49. 22. 48.

    At *Sourdon*   49. 43. 40.

    At *Noftre Dame d' Amiens*   49. 54. 46.

As

As to Differences of Longitudes ;

Sourdon		Amiens			o°.	5'.	54".
Clermont		Sourdon			o.	1.	9.
Mareuil	more Easterly then	Clermont	by		o.	o.	34.
Mareuil		Malvoyfin			o.	o.	20.
Mareuil		Paris			o.	4.	37.

So much of the *eleventh* Article. The *twelfth* is framed upon an *Objection*, that might be made, *viz.* Whether the Meafure is the fame taken at *Paris*, with that which is taken upon a Level by the Sea-fide. Here he computes upon the fall of the River *Seine*, and judgeth the place where he meafured to be raifed above the Sea not more then 80 Toifes ; and concludes the Difference between meafuring at *Paris* and by the *Sea* not above 8 feet *per* degree. Where he makes a Table of *Levels* ; defcribes an Inftrument to take Levels with ; difcourfes of Refractions, and how to correct them.

In the *thirteenth* Article he examins feveral opinions, different from his, concerning this fubject ; as of *Fernelius, Snellius*, and *Riccioli* ; and points at the occafions of their refpective miftakes ; delivering withal the Differences of their Meafures from his. Of the three, *Fernelius* comes the nigheft ; which M. *Picart* imputes to meer chance, fince he ufed not half the exactnefs in obferving that *Snellius* did. *Snellius* his difference from accuratenefs he attributes, 1. To too fmall a bafe, he took to meafure, and to too fmall triangles, which he was forced to take afterwards : 2. To the want of fo good Inftruments, as were employed in thefe Obfervations.

To adde fomething of the *three Figures* ; they reprefent the Connexion of Triangles, by which our Author meafur'd the Diftance from *Malvoyfin* to *Sourdon*, and from *Sourdon* to *Amiens* : From which meafure he concluded, what the juft length of a *Degree* might be, reduced to the Parifian Toife.

Concerning which Triangles nothing more needs to be added, but only a fuller Explication of what the Letters in them do ftand for ; *viz.*

A. the middle-point at the Mill of *Villejuifve*.
B. the neareft corner of the Pavillon of *Ivoify*.
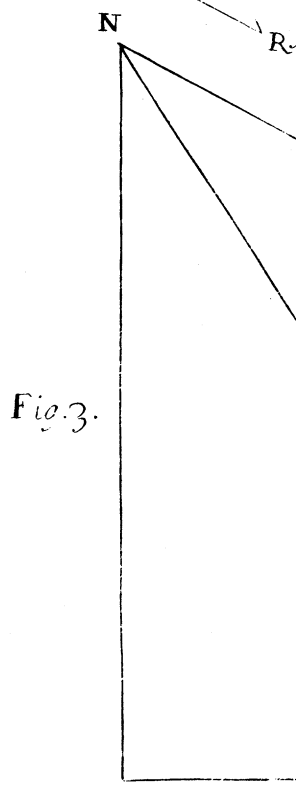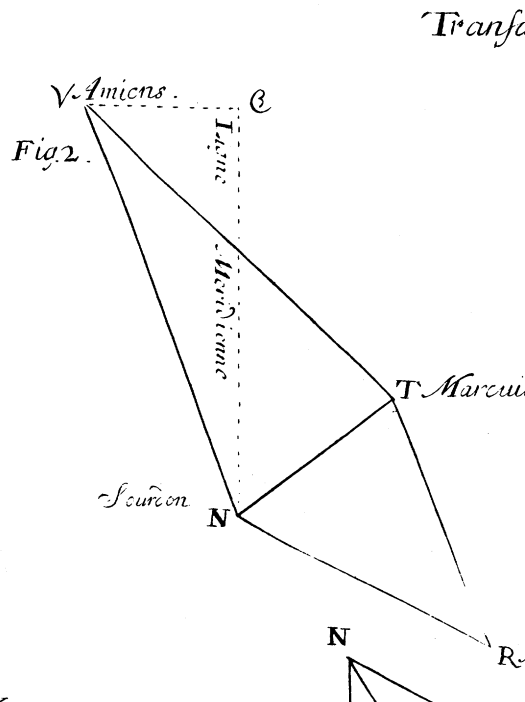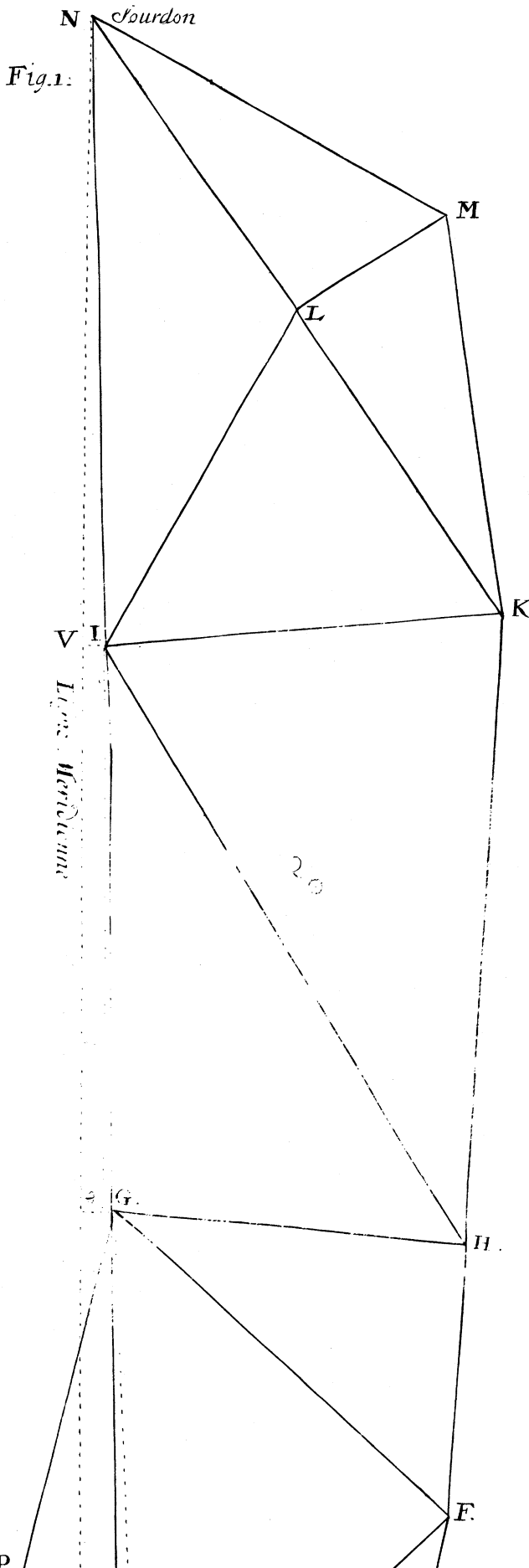C. the top of the Steeple of *Brie Compte Robert*.

D. the

D. the middle of the Tower of *Montlehery*.

E. the top of the Pavillon of *Malvoyfin*.

F. a pole placed for this purpofe on the ruins of the Tower of *Montjay*, with a lock of hay put upon it, that it might be feen at a greater diftance.

G. the middle of the Hummock of *Mareuil* , where it was re-quifite to have a fire made , to diftinguifh it at a di-ftance.

H. the middle of the great Oval Pavillon of the Caftle of *Dam-martin*.

I. the Tower of St. *Sampfon* in *Clermont*.

K. the Mill of *Jonquieres* near *Compiegne*.

L. the Tower of *Coyvrel*.

M. a little Tree on the hill of *Boulogne* near *Montdidier*.

N. the Tower of *Sourdon*.

O. a little forked Tree upon the point of the *Griffon* neer *Ville-neuve St. George*.

P. the Tower of *Montmartre*.

Q. the Tower near St. *Chriftopher* at *Senlis*.

Thus we have given you, we hope, fome fatisfaction as to this point , at leaft as to the material parts of it. As to all the par-ticular niceties , (which it would be too tedious to defcribe) the Book it felf, which furely fome time or other will come abroad, may render that fatisfaction compleat.

Mean time, I would by no means, that this fhould put a ftop to the Ingenuity and Induftry of our Philofophical Friends here in *England* , or deprive either them of the pleafure of compa-ring their exactnefs with that of M. *Picarts*, or the world of the advantage of having fo important a Problem refolved by di-vers Artifts in different Countries, by different wayes ; that fo, the whole comming to be reflected upon, one may be able to conclude from the accuratenefs of the Obfervers , who they are that are come the neareft to truth in their Obfervations.

An Extract of the French Journal des Scavans, *concerning a New Invention of Monfieur* Chriftian Hugens de Zulichem, *of very exact and portative Watches.*
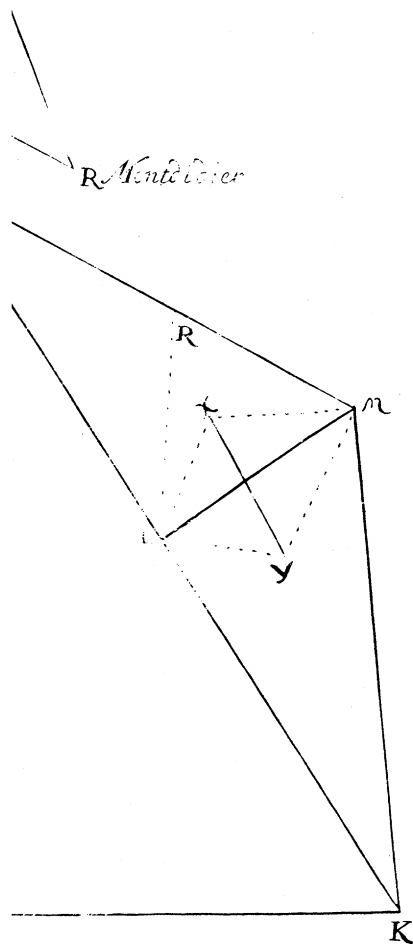
THE Watches of this Invention being made in fmall, fhall ferve for very exact Pocket-watches, and when made greater, fhall
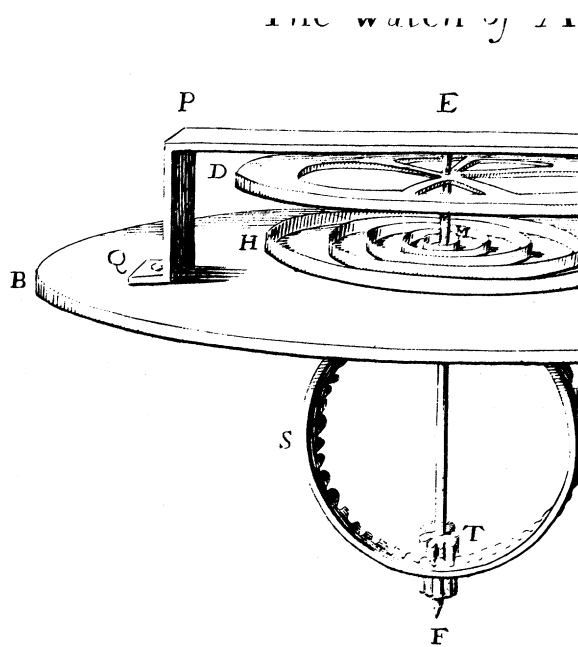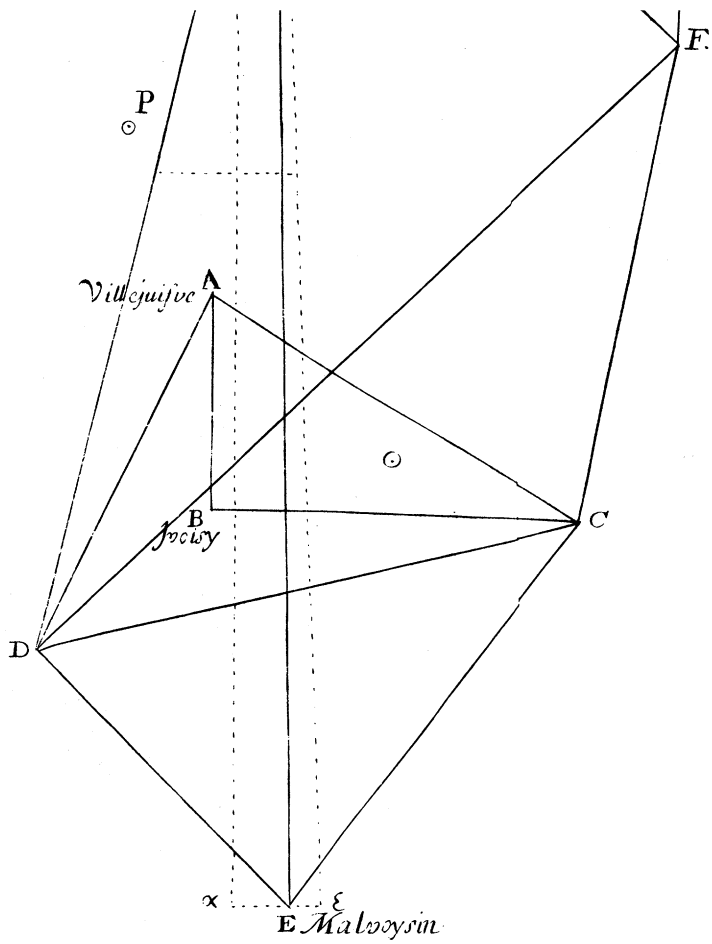
Fig.1.

N *Jourdon*

M

L

V **I**

Ligne Meridienne

K

? ⊙

G.

H.

F.

P

Fig.2.

V *Amiens*

C

Ligne Meridienne

T *Marcui...*

Jourdon

N

Fig.3.

N

R.

P

E

Marœuil.

R *Mentœlier*

R

c   n

y

K

of M. Hugens.

P
⊙

Villejuive A

⊙

B
Jvoisy

D

⊙

F.

C

x   ε
E Malvoysin

The watch of A...

P   E

D

H

B   Q

S

T

F